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## ***Interactive comment on “Big grains go far: reconciling tephrochronology with atmospheric measurements of volcanic ash” by J. A. Stevenson et al.***

### **Anonymous Referee #4**

Received and published: 3 February 2015

#### General comments:

This paper addresses an important question by seeking to resolve the discrepancy between particle sizes reported in satellite-based estimates of volcanic ash plumes and particle sizes found in ground-based observations of fallen ash. Though the paper does not give a single definitive answer, it clearly identifies factors that contribute to the discrepancy and makes important steps toward fully resolving the puzzle.

The manuscript is well written and is accessible even for a reader not intimately familiar with its topic. Having a background more closely related to the remote sensing aspect

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of the manuscript, I especially appreciate the very good overview of large large ash particles found on the ground. While the methodology and results are sound, I believe the manuscript would benefit from additional discussions and clarifications. As a result my suggestion is to make some major revisions before final publication. Please find my specific comments below.

Major specific comments:

Page 71, line 5, or Page 88, Line 13, or somewhere else in the paper: In addition to the BTM-based retrieval technique, are there other techniques for satellite-based characterization of volcanic ash plumes? (Perhaps some of the ash-detection approaches mentioned in lines 17-22 of page 70, or methods using satellite-based short-wave reflectances, multi-angle measurements, or lidar data can also characterize ash plumes?) It would help to mention any relevant methods other than the BTM method discussed in the paper, or to mention that currently there are no alternative methods available.

Page 80, Lines 13-15, and elsewhere: It would be helpful to include a note on the effects of applying Mie theory to non-spherical particles. Would the findings likely change substantially if ash grain radiative properties were calculated by a method that considers the non-spherical shape of particles?

Page 90, Lines 89-90: I wonder if this sentence suggests that the lognormal approximation of the size distribution may not be accurate. In either case, it would help to clarify both this sentence and the last sentence of the paragraph. (I guess the lack of 10-17 micron retrieval results implies that the tail of particle size distribution is not the only factor, because it shows a general underestimation of particle sizes.) Also, regardless of these sentences, it would help to briefly discuss somewhere the realism of the lognormal size distribution approximation, and whether using another size distribution approximation may substantially change the findings.

Page 91, Line 5: It would help to clarify what is meant by “preferable”. Does the defini-

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tion of the cost function imply that smaller particle sizes tend to have lower cost function values? If so, could a different cost function or incorporating additional observations (for example at much shorter or longer wavelengths) help?

Minor specific comments:

Page 69, Line 4: At this point readers are not yet familiar with the expression “BTD-active”, and so deleting or clarifying this would help.

Page 79, Lines 22-24; Page 85, Lines 8-10; and/or Figure 12 caption: It would help to mention why the rhyolite grains fall slower (and thus travel farther) than basaltic ones do. This may well be discussed in the Riley et al. (2003) reference, but mentioning it here would spare readers from having to look up that paper in order to understand the presented results.

Page 81. Lines 4-6: While the simulations assume no water or ice clouds, Lines 17-19 in Page 86 say that in reality there were some clouds around the ash plume. Thus it might help to point out here whether and how including water and ice clouds into the simulations may change the results.

Page 83, Line 6: The acronym VAAC should be defined.

Page 83, Line 15: The word “reducing” should be replaced by an adjective, for example “reduced” or “weak”.

Page 90, Line 12: It would help to mention why the geometric mean may be more appropriate for the comparisons than the arithmetic mean. If the paper used geometric as opposed to arithmetic mean values throughout, the manuscript could indicate this just as it points out that the used standard deviations are geometric.

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 65, 2015.

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